CHAPTER 10. RADAR PROCEDURES

1000. GENERAL. This chapter applies to approach procedures based on the use of ground and airborne radar. Four types of radar procedures are covered:

a. Precision Approach Radar. A radar display of azimuth, range, and glide slope information, which provides for precision approaches to a runway.

b. Airport Surveillance Radar. A radar installation with a display of azimuth and range, which provides a radar vectoring capability for final approach to an airport.

c. Simultaneous Radar Procedures. A radar or radars which serve parallel runways and provide for simultaneous approaches to authorized minimums.

d. Airborne Radar. A radar installation in an aircraft with a display of azimuth and range which provides a capability for an instrument approach when used with appropriate terrain, reflector, or transponder return.

1001.–1009. RESERVED.

Section 1. Precision Approach Radar (PAR)

1010. SYSTEM COMPONENTS. A PAR system consists of a precision approach radar facility which meets the requirements for the operating agency.

1011. INOPERATIVE COMPONENTS. Failure of azimuth and range information renders the entire PAR inoperative. When the glide slope feature becomes inoperative, the PAR reverts to a non-precision approach system and non-precision minimums (paragraph 350) apply. In this case, obstacle clearance shall be as specified in paragraph 953 for localizer and LDA approaches.

* **1012. LOST COMMUNICATION PROCEDURES.** The PAR procedure shall include instructions for the pilot to follow in the event of a loss of communications with the radar controller. Alternate lost communications procedures shall be established for use where multiple approaches are authorized. *

1013. FEEDER ROUTES AND INITIAL APPROACH SEGMENTS. Navigational guidance for feeder routes and initial segments may be provided by surveillance radar, other navigation facilities, or a combination thereof. When radar is used as the primary means of navigation guidance, the criteria specified in Section 4 of this chapter shall apply. When other navigational facilities are used as the primary means of navigational guidance, the criteria specified in Chapter 2, Sections 2 and 3, shall apply as appropriate.

1014. INTERMEDIATE APPROACH SEGMENT. Navigational guidance in the intermediate segment may be provided by ASR, PAR, other navigation facilities, or combination thereof. Except as stated in this paragraph, the criteria for the intermediate segment are contained in Chapter 2, Section 4. The intermediate segment begins at the point where the initial approach course intercepts an extension of the final approach course. This extension is the intermediate course. It extends along the inbound final approach course to the point of interception of the glide path. The minimum length of the intermediate segment depends on the angle at which the initial approach course intercepts the intermediate, and is specified in Table 20. The MAXIMUM angle of interception shall be 90°.

Table 20. INTERMEDIATE SEGMENT ANGLE OF INTERCEPT VS. SEGMENT LENGTH.

Maximum Angle (Degrees)	Minimum Length (Miles)
15	1
30	2
45	3
60	4
75	5
90	6

NOTE: This table may be interpolated.

1015. DESCENT GRADIENT. Even though the minimum length of the intermediate segment may be less than that specified in Chapter 2, Section 4, intermediate descent criteria specified in paragraphs 242d and 243d shall be applied to at least 5 miles of flight track immediately prior to the glide slope intercept point.

1016. ALTITUDE SELECTION. Altitudes selected for the initial approach and intermediate approach segments provide required obstacle clearance as specified in Chapter 2. In addition, the selected altitudes shall NOT be less than the glide slope interception altitude. Where PAR and ILS serve the same runway, the glide slope interception altitude should be the same for both, and the point of interception should be the outer marker wherever possible.

1017.–1019. RESERVED.

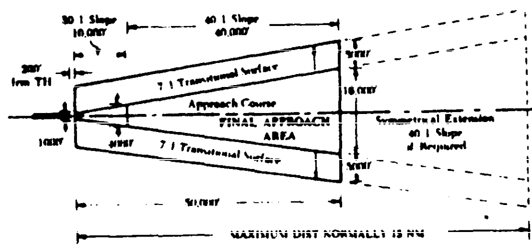


Figure 98. PAR FINAL APPROACH AREA. Par 1020.b.

Section 2. PAR Final Approach

1020. FINAL APPROACH SEGMENT. The final approach segment begins at the final approach fix (FAF). The FAF in PAR procedures is the point where interception of the glide slope occurs. The point of glide slope interception shall NOT be less than 3 miles from the landing threshold. When the glide slope is inoperative, the FAF is a point on the final approach course within 5 miles of the landing threshold but not less than the distance required by descent gradient criteria. The FAF for procedures without a glide slope should coincide with the FAF for PAR.

a. Alignment. The final approach course shall be aligned with the runway centerline.

b. Area. The area considered for obstacle clearance in the final approach segment consists of a final approach area and transitional surfaces (see paragraph 1022). The final approach area has the following dimensions:

(1) **Length.** The final approach area is 50,000 feet long, measured outward along the final approach course from a point beginning 200 feet outward from the runway threshold. Where operationally required by other procedural considerations due to existing obstacles, the length may be increased as shown in Figure 98. The final approach area used shall only be that portion of the area which is between the glide slope interception point and the point 200 feet from the runway threshold.

(2) **Width.** The final approach area is centered on the extended runway centerline. The area has a total width of 1,000 feet at the point 200 feet from the threshold and expands uniformly to a total width of 16,000 feet at a point 50,000 feet from the point of beginning. This width further expands uniformly where a greater length is required as in paragraph 1020b(1). See Figure 98. The width either side of the centerline at a given distance "D" from the point of beginning can be found by using the formula $500 + .15D = 1/2W$. For example, if D is 50,000 feet; $500 + .15 \times 50{,}000 = 8{,}000$, which is 1/2 the width. Therefore, the total width is 16,000 feet at the 50,000 foot point.

NOTE: ***Where glide slope interception occurs at a distance greater than 50,200 feet from the threshold, the final approach area and the final approach surface may be extended symmetrically to a maximum distance dictated by the usability of the glide slope.***

1021. FINAL APPROACH OBSTACLE CLEARANCE SURFACE. The final approach obstacle clearance surface is an inclined plane which originates at the runway threshold elevation 975 feet outward from the GPI, and which overlies the final approach area. The surface is divided into two sections, an inner 10,000-foot section and an outer 40,000-foot section. The slope of the surface changes at the 10,000-foot point. The exact gradient may differ according to the angle at which the glide slope is established. The 50:1 and 40:1 slopes which are applicable to the 2 1/2° glide slope shall be established unless other slopes must be used to assure required clearance over existing obstacles. Table 21 specifies the slopes which provide required obstacle clearance for several glide slope angles. See also paragraph 1025.

Table 21. GS ANGLE VS. FINAL APPROACH SURFACE SLOPE RATIOS.

GS Angle (Degrees)	Approximate Slope of Inner Section	Approximate Slope of Outer Section
2	96.5:1	61.5:1
2 1/4	66:1	48.5:1
2 1/2	50:1	40:1
2 3/4	40.5:1	34:1
3	34:1	29.5:1

NOTE: See graph, Appendix 2, Figure 132 for interpolation.

1022. TRANSITIONAL SURFACES. Transitional surfaces for PAR are inclined planes with a slope of 7:1 which extend outward and upward from the edges of the final approach area, starting at the height of the applicable final approach surface and extending for a lateral distance of 5,000 feet at right angles to the runway centerline. See Figure 98.

1023. DELETED.

1024. OBSTACLE CLEARANCE OUTSIDE THE DH POINT. No obstacle shall penetrate the applicable final approach obstacle clearance surface specified in paragraph 1021 or the transitional surfaces specified in paragraph 1022. The required obstacle clearance is based on the difference between the glide slope angle and the appropriate final approach surface specified in paragraph 1021. To determine the minimum required obstacle clearance in feet at any distance "D" from the GPI the following formula may be used:

For "D" less than 10,975 feet, the minimum required clearance is .02366 D + 20 feet. See also paragraph 1025.

For "D" 10,975 feet or over, the minimum required clearance is .01866 D + 75 feet.

NOTE: *The clearance provided by the formula is a MINIMUM requirement. Obstacle clearance greater than 500 feet need not be applied unless required in the interest of safety due to such factors as precipitous terrain or PAR installation peculiarities. The Nomograph in Figure 99 provides a simple method of determining the minimum obstacle clearance requirements. Also included in Figure 99 is an example of a method for determining the required glide slope angle. For additional obstacle limitations see paragraph 1025.*

1025. OBSTACLE CLEARANCE INSIDE THE DH POINT. The lowest landing minimums as specified in paragraph 350 may be approved when
* no obstacles penetrate the final approach obstacle clearance surface applicable to the commissioned glide slope angle, beginning 200 feet outward from the threshold and at least 975 feet from the GPI, and extending to the DH point. When penetration of this surface exists, consideration should be given to the removal of the obstacle or relocation of the landing threshold. See Figure 131. *

1026. GLIDE SLOPE. In addition to the required obstacle clearance, the following shall apply to the selection of the glide slope angle and antenna location.

a. Glide Slope Angle. The optimum glide slope angle is 2 1/2°. Angles less than 2° or more than 3° shall not be established without the authorization of the approving authority. Where PAR serves a runway that is also served by ILS and/or VASI, the PAR, ILS, and VASI glide slope angles and RPI shall coincide. The PAR glide slope angle shall be within 0.20° of the ILS/VASI glide slope angle and the RPI shall be within plus or minus 50 feet of the ILS/RPI and/or VASI runway reference point (RRP).

b. Glide Slope Threshold Crossing Height. The optimum threshold crossing height is 50 feet. The MAXIMUM height is 60 feet. A height as low as 32 feet for military airports may be used at locations where special considerations of the glide path angle and antenna location are required. Where the glide slope threshold crossing height exceeds 60 feet, consideration shall be given to the relocation of the landing threshold to insure effective placement of the approach light system. See Appendix 2 for a method of computing the threshold crossing height.

1027. RELOCATION OF GLIDE SLOPE. Where minimum obstacle clearance cannot be obtained with a 3° glide slope angle, and sufficient length of runway is available, the glide slope may be moved the required distance down the runway to obtain the minimum obstacle clearance in the final approach area. Where the glide slope threshold crossing height exceeds 60 feet, consideration should be given to relocating the landing threshold to insure effective placement of the approach light system. The minimum distance between the GPI and the runway threshold is 775 feet. (No minimum GPI distance need be applied to military locations provided minimum ROC and TCH standards are met).

1028. DECISION HEIGHT (DH)

a. Minimum Decision Height. For PAR the decision height above the touchdown zone shall be no lower than 100 feet for military procedures and 200 feet for civil procedures.

b. Adjustment of Decision Height.

(1) **Primary Final Approach Surface.** When minimum obstacle clearance cannot be obtained with a 3° glide slope angle, and the approving authority will not approve an angle in excess of 3°, and the runway length does not permit a compensating adjustment, the decision height shall be increased accordingly. To establish the minimum decision height which can be authorized, extend a line horizontally outward from the top of each penetrating obstacle, parallel with the runway centerline, to a point of interception with the established final approach obstacle clearance surface. From the controlling point, extend a line vertically to a point of interception with the glide slope. The height at the point of intersection with the glide slope is the minimum decision height, except that application of this method need not require a decision height that is more than 250 feet above the obstacle. This decision height shall not be less than 250 feet. See Figure 79.

(2) **Transitional Surface.** Where minimum obstacle clearances cannot be met in the transitional surfaces, and when deemed necessary, consideration will be given to an adjustment in the decision height commensurate with the degree of interference presented by the particular obstacle or obstacles. See Figure 79.

1029. RESERVED.

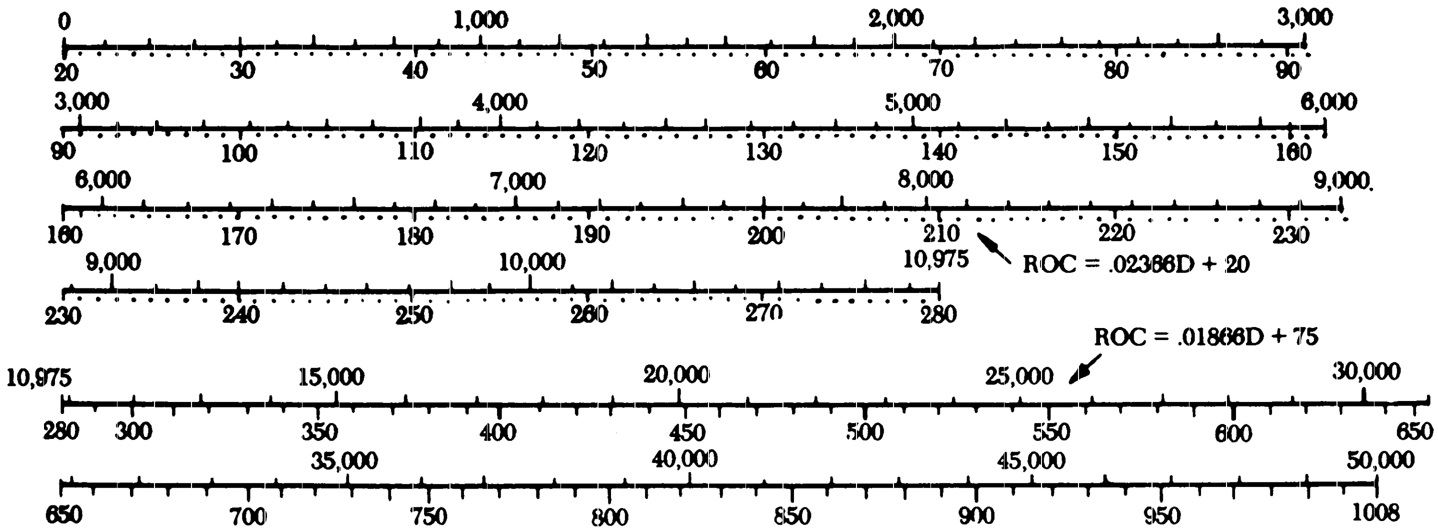
Section 3. PAR Missed Approach

1030. MISSED APPROACH SEGMENT. The missed approach segment begins at the missed approach point and ends at an appropriate point or fix where initial approach or en route obstacle clearance is provided. Missed approach procedures shall be based on positive course guidance where possible.

1031. MISSED APPROACH POINT (MAP). The missed approach point is a point on the final approach course where the height of the glide slope is equal to the authorized decision height.

1032. STRAIGHT MISSED APPROACH. The straight missed approach area (maximum of 15° turn from final approach course) starts at the MAP. The length of the area is 15 miles measured along the missed approach course. The area has a width equal to that of the final approach area at the missed approach point and a width equal to that of the initial approach area at a point 15 miles from the MAP. The missed approach area is divided into 2 sections.

* a. *Section 1* starts at the MAP and is longitudinally centered on the missed approach course. It has the same width at the MAP as the final approach area. *



The lowest glide slope that will provide the required obstacle clearance (ROC) over a critical obstacle is found by the formula:

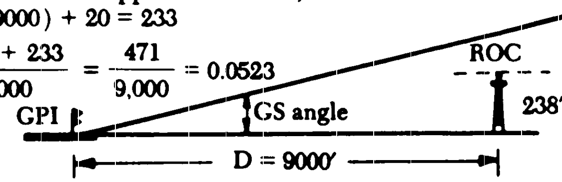
$$\text{Tan of GS angle} = \frac{\text{Obstacle height} + \text{ROC}}{\text{GPI to obstacle Distance}}$$

EXAMPLE:

Controlling obstacle is 238 feet above runway elevation and 9000 feet from the GPI. Find the minimum GS angle

From the nomograph find 233 feet opposite 9000 feet, or use the formula (0.02366 × 9000) + 20 = 233

$$\text{Tan of GS angle} = \frac{238 + 233}{9000} = \frac{471}{9{,}000} = 0.0523$$



Arc Tan 0.0523 = 3.0 degrees

NOTE: A method with an example of criteria application (Paragraphs 1021 through 1025) is included in Appendix 2.

Figure 99. PAR OBSTACLE CLEARANCE NOMOGRAPH. Par 1024

b. Section 2 starts at the end of Section 1 and is centered on a continuation of the Section 1 course. The width increases uniformly from 1 mile at the beginning to 12 miles at a point 13.5 miles from the beginning. A secondary area for reduction of obstacle clearance is identified within Section 2. The secondary area is zero miles wide at the beginning and increases uniformly to 2 miles wide at the end of Section 2. Positive course guidance is required to reduce obstacle clearance in the secondary area. See Figure 100.

1033. TURNING MISSED APPROACH. Where turns of more than 15 degrees are required in a missed approach procedure, they shall begin at an altitude which is at least 400 feet above the elevation of the touchdown zone. Such turns are assumed to begin at the point where Section 2 begins. The flight track and obstacle clearance radii used shall be as specified in Table 5, paragraph 275. To determine the length of Section 1:

a. Add 400 feet to touchdown zone elevation.

b. Round to next higher 100 foot increment.

c. Subtract the decision height value from the result of steps a & b.

d. Divide the result by 152 to obtain the required length of Section 1 in nautical miles.

e. Minimum length of Section 1 shall be 1.5 NM.

The width at the end of Section 1 is determined by symmetrically extending Section 1 to the required

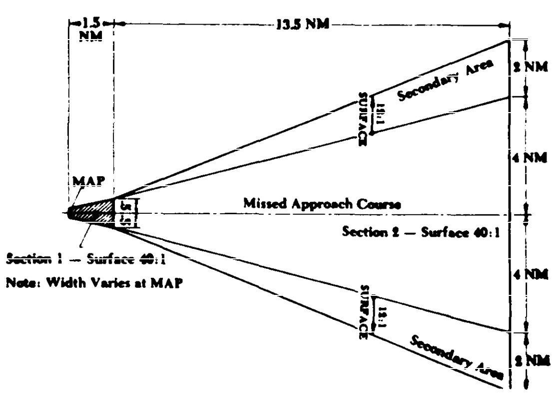


Figure 100. PAR STRAIGHT MISSED APPROACH AREA.
Par 1032.b.

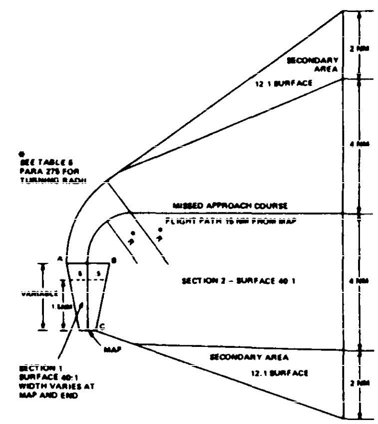


Figure 101. PAR TURNING MISSED APPROACH AREA.
Par 1033

length. The inner boundary of Section 2 shall begin at the edge of Section 1 opposite the MAP. The outer and inner boundary lines shall flare to the width of the initial approach area at 15 NM from the MAP measured along the flight path. Secondary areas for reduction of obstacle clearance are identified within Section 2. The secondary areas begin after completion of the turn. They are zero miles wide at the point of beginning and increase uniformly to 2 miles wide at the end of Section 2. Positive course guidance is required to reduce obstacle clearance in the secondary areas. See Figure 101.

1034. MISSED APPROACH OBSTACLE CLEARANCE.

a. Straight Missed Approach Area. No obstacle in Section 1 or Section 2 may penetrate a 40:1 surface which originates at the MAP at the height of the final approach surface, but not more than 250 feet below the DH, and which overlies the entire missed approach area.

b. Turning Missed Approach Area. Section 1 obstacle clearance is the same as that for straight missed approaches. To determine the obstacle clearance requirements in Section 2, the dividing line between Section 1 and 2 is identified as "A-B-C". The height of the missed approach surface over any obstacle in Section 2 is determined by measuring the distance from the obstacle to the nearest point on line A-B-C, and computing the height according to the 40:1 ratio, starting at the height of the missed approach surface at the end of Section 1.

c. Secondary Areas. Where secondary areas are considered, no obstacle may penetrate a 12:1 surface which slopes outward and upward from the missed approach surface.

d. Discontinuance. Where the 40:1 surface reaches a height of 1000 feet below the missed approach altitude (Paragraph 270) further application of the surface is not required.

1035. COMBINATION STRAIGHT AND TURNING MISSED APPROACH AREA. If a straight climb to an altitude greater than 400 feet is necessary prior to commencing a missed approach turn, a combination straight and turning missed approach area must be constructed. The straight portion of this missed approach area is divided into Sections 1 and 1A. The portion in which the turn is made is Section 2.

a. Straight Portion. Sections 1 and 1A correspond respectively to Sections 1 and 2 of the normal straight missed approach area and are constructed as specified in Paragraph 1032 except that Section 1A has no secondary areas. Obstacle clearance is provided as specified in Paragraph 1034.b. The length of Section 1A is determined as shown in Figure 102 and relates to the need to climb to a specified altitude prior to commencing the turn. The line A′-B′ marks the end of Section 1A. Point C′ is 9000 feet from the end of Section 1A (see Figure 102).

b. Turning Portion. Section 2 is constructed as specified in Paragraph 1033 except that it begins at the end of Section 1A instead of the end of Section 1. To determine the height which must be attained before commencing the missed approach turn, first identify the controlling obstacle on the side of Section 1A to which the turn is to be made. Then measure the distance from this obstacle to the nearest edge of the Section 1A area. Using this distance as illustrated in Figure 102 determine the height of the 40:1 slope at the edge of Section 1A. This height plus 250 feet (rounded off to the next higher 20 foot increment) is the height at which the turn should be started. Obstacle clearance requirements in Section 2 are the same as those specified in Paragraph 1034.b except that Section 2 is expanded to start at Point C if no fix exists at the end of Section 1A or if no course guidance is provided in Section 2 (see Figure 102).

1036. – 1039. RESERVED.

Section 4. Airport Surveillance Radar (ASR)

1040. GENERAL. This section applies to approach procedures based on the use of ASR. ASR may be used to provide primary navigation guidance within the operational coverage of the radar. ASR approaches may be established where the coverage and alignment tolerances specified in the U.S. Standard Flight Inspection Manual can be met and the airport is not more than 20 miles from the radar antenna.

1041. INITIAL APPROACH SEGMENT. The initial approach segment begins at the position the aircraft is in when radar contact is established, and ends at the intermediate fix. Radar guidance may be used in pre-established patterns or may be provided by diverse vectors issued by the radar controller.

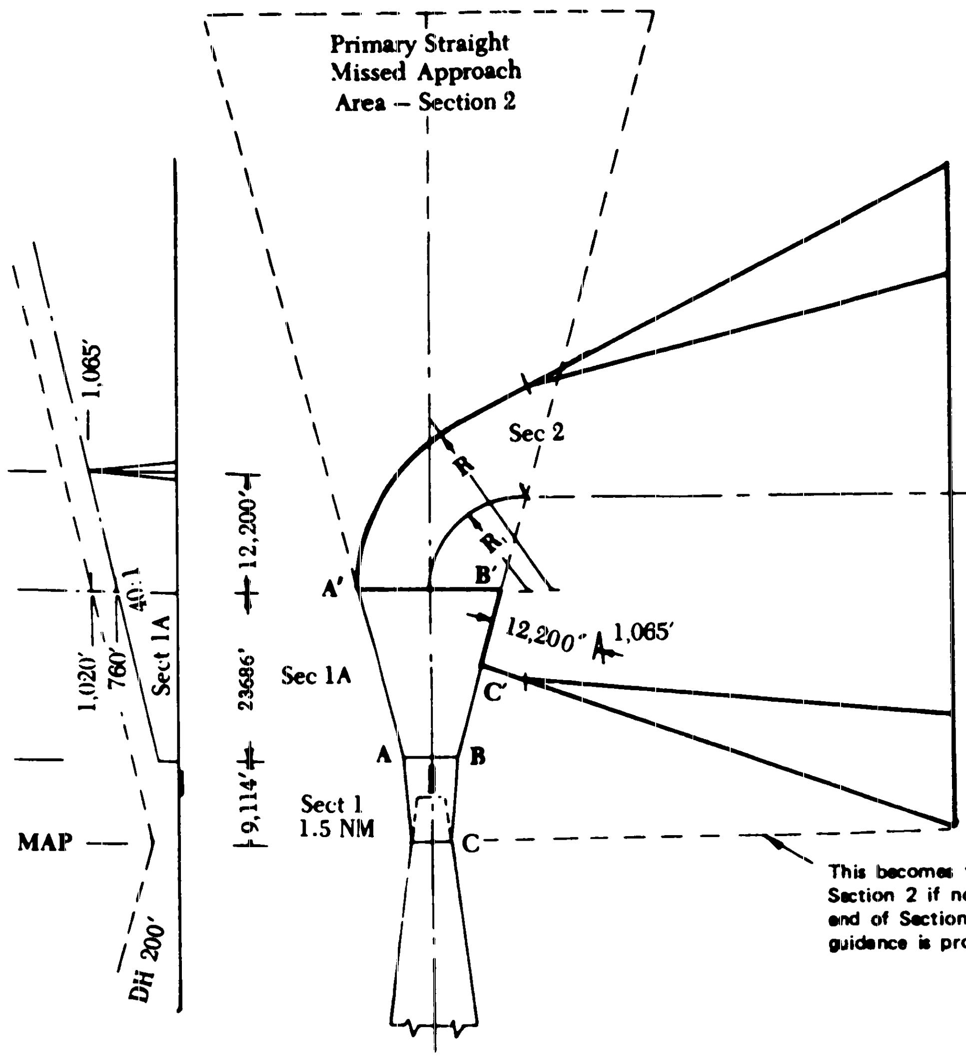
a. Radar Patterns. Radar patterns shall begin at an established fix or point which permits positive radar identification.

(1) Alignment. The initial approach course, or courses, shall be selected to coincide with aircraft maneuvering capability and to satisfy air traffic flow requirements. The angle at which the initial approach course joins the intermediate course shall not exceed 90 degrees.

(2) Area. The area considered for obstacle clearance is 3 miles (5 miles at distances greater than 40 miles from the radar antenna) either side of the designated pattern course. There is no secondary area. The area has no specific maximum or minimum length. However, the initial approach must be long enough to permit the altitude loss required by the procedure at the authorized descent gradient.

NOTE: Air Route Surveillance Radar (ARSR) may be used to provide course guidance up to and including the intermediate fix or point.

(3) Obstacle Clearance. A minimum of 1000 feet of clearance shall be provided over all obstacles in the initial approach area. Clearance over a prominent obstacle which is displayed as a permanent echo on the radar scope may be discontinued after the aircraft has been observed to pass the obstacle. Allowance for precipitous terrain should be made as specified in Paragraph 323. The altitudes selected by application of the obstacle clearance criteria specified in this paragraph may be rounded to the nearest 100 feet. See Paragraph 1043.



EXAMPLE:

DH is 200' MSL.

A 1065' controlling obstacle is 12200' from the near edge of Sec. 1A.

A 40:1 surface which clears the obstacle has a height of 760' MSL at the near edge of Section 1A.

12200' ÷ 40'=305'

1065' – 305'=760'

To determine minimum altitude at which the missed approach aircraft may start the turn add 250' obstacle clearance and round up the sum to the next higher 20' increment.

760' + 250' = 1010'

Rounded up = 1020'

To climb 820' from DH 200' to the turning altitude (1020' MSL) at the 40:1 climb gradient requires 32800'. Sec. 1 is 9114' long; therefore, Section 1A is required to be 23686' long.

Figure 102. COMBINATION STRAIGHT AND TURNING MISSED APPROACH AREA. Par 1035.

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after the aircraft has been observed to pass the obstacle. Allowance for precipitous terrain should be made as specified in Paragraph 323. The altitudes selected by application of the obstacle clearance criteria specified in this paragraph may be rounded to the nearest 100 feet. See Paragraph 1043.

(4) Descent Gradients. The OPTIMUM descent gradient in the initial approach is 250 feet per mile. Where a higher descent gradient is necessary, the MAXIMUM permissible gradient is 500 feet per mile. The OPTIMUM descent gradient for high altitude penetrations is 800 feet per mile. Where a higher descent gradient is necessary, the MAXIMUM permissible gradient is 1000 feet per mile.

b. Diverse Vectors. Navigation guidance of an aircraft by diverse vectors issued by the radar controller may commence upon positive radar identification.

(1) Alignment. Diverse vectors issued by the controller are selected to coincide with aircraft maneuvering capability and to satisfy air traffic flow requirements.

(2) Area. The area considered for obstacle clearance shall be the entire area within the operational coverage of the radar. This area may be sub-divided to gain relief from obstacles which are clear of the area in which flight is to be conducted. There is no prescribed limit on the size, shape, or orientation of these sub-divisions; however, they shall be designed to emphasize simplicity and safety in radar air traffic control applications.

(3) Obstacle Clearance. A minimum of 1000 feet of clearance shall be provided over all obstacles within the operational coverage of the radar or within the appropriate subdivision where subdivisions have been established. Altitudes established for use shall also provide 1000 feet of clearance over all obstacles outside of the subdivision within 3 miles of the subdivision boundary (5 miles at distances greater than 40 miles from the antenna). Clearance over a prominent obstacle which is displayed as a permanent echo on the radar scope may be discontinued after the aircraft has been observed to pass the obstacle. Allowance for precipitous terrain should be made as specified in Paragraph 323. The altitudes selected by application of the obstacle clearance criteria specified in this paragraph may be rounded to the nearest 100 feet. See Paragraph 1043.

(4) Descent Gradient. The OPTIMUM descent gradient in the initial approach is 250 feet per mile. Where a higher descent gradient is necessary, the MAXIMUM permissible gradient is 500 feet per mile. The OPTIMUM descent gradient for high altitude penetrations is 800 feet per mile. Where a higher descent gradient is necessary, the MAXIMUM permissible gradient is 1000 feet per mile.

1042. INTERMEDIATE APPROACH SEGMENT. The intermediate segment begins at the radar fix where the initial approach course intersects an extension of the final approach course. This extension is the intermediate course, and the point of intersection is the intermediate fix. The intermediate segment extends along the intermediate course inbound to the point where final approach descent commences. This point is the final approach fix.

a. Alignment. The intermediate course is an extension of the final approach course.

b. Area. The width of the intermediate segment is 3 miles either side of the course at the intermediate fix. It tapers to the width of the final approach area at the final approach fix. There are no secondary areas. The length of the intermediate segment shall not exceed 15 miles. The minimum length of the intermediate segment depends on the angle at which the initial approach course intercepts the intermediate course, and is specified in the table below. The MAXIMUM angle of interception shall be 90 degrees.

c. Obstacle Clearance. A minimum of 500 feet of clearance shall be provided over all obstacles in

Table 22. INTERCEPTION ANGLE VS. LENGTH OF INTERMEDIATE SEGMENT.

Maximum Angle of Interception (Degrees)	Minimum Length of Segment (Miles)
15	1
30	2
45	3
60	4
75	5
90	6

NOTE: This Table may be interpolated. See Figure 75.

the intermediate area. Allowance for precipitous terrain should be made as specified in Paragraph 323. Clearance over a prominent obstacle which is displayed as a permanent echo on the radar scope may be discontinued after the aircraft has been observed to pass the obstacle. The altitudes selected by the application of the obstacle clearance criteria specified in this paragraph may be rounded to the nearest 100 feet. See Paragraph 1043.

d. Descent Gradient. Because the intermediate segment is used to prepare the aircraft speed and configuration for entry into the final approach segment, the descent gradient should be as flat as possible. The OPTIMUM descent gradient should not exceed 150 feet per mile. The MAXIMUM descent gradient is 300 feet per mile. When the length of the intermediate segment is less than specified in Paragraph 242, intermediate descent criteria shall be applied to at least 5 miles of flight track immediately prior to the FAF.

1043. ALTITUDE SELECTION. Altitudes selected for the initial and intermediate approach segments shall be established in 100 foot increments. For example, 1149 feet may become 1100 feet; and 1150 feet shall become 1200 feet.

1044. FINAL APPROACH SEGMENT. The final approach begins at the final approach fix, which is a radar fix and ends at the runway or missed approach point, whichever is encountered last.

a. Alignment. The final approach course shall be aligned on the extended runway centerline for straight-in approach and to the center of the airport for circling approach. When an operational advantage can be achieved, the final approach course for circling may be aligned to any portion of the usable landing surface.

b. Area. The area considered for obstacle clearance begins at the final approach fix and ends at the runway or missed approach point, whichever is encountered last, and is centered on the final approach course. The minimum length of the final approach area shall be 3 miles. The maximum length should not exceed 6 miles. See Figure 103. The width of the primary area (Wp) is based on a formula which provides 2 miles of width at the radar antenna, increasing to 6 miles of width at a distance (D) of 20 miles from the radar antenna. The formula is $1/2Wp = 0.1D + 1$ mile. There are no secondary areas. See Figure 104.

c. Obstacle Clearance.

(1) Straight-In. A minimum of 250 feet of clearance shall be provided over all obstacles in the final approach area, except that where a prominent obstacle which is displayed as a permanent echo on the radar scopes exists it need not be considered for obstacle clearance after the aircraft is observed to have passed the obstacle. Allowance for precipitous terrain as specified in Paragraph 323 should be made.

(2) Circling. In addition to the minimum requirements specified in Paragraph 1044.c.(1) obstacle clearance in the circling area shall be as prescribed in Chapter 2, Section 6.

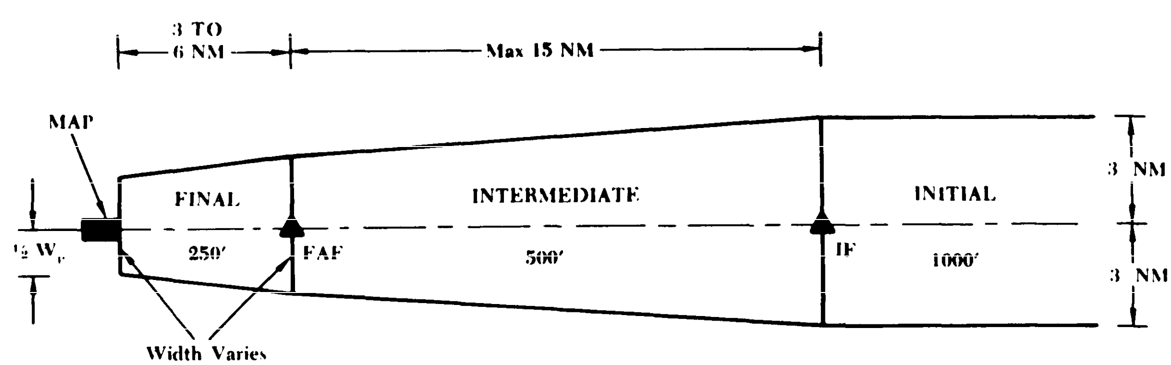
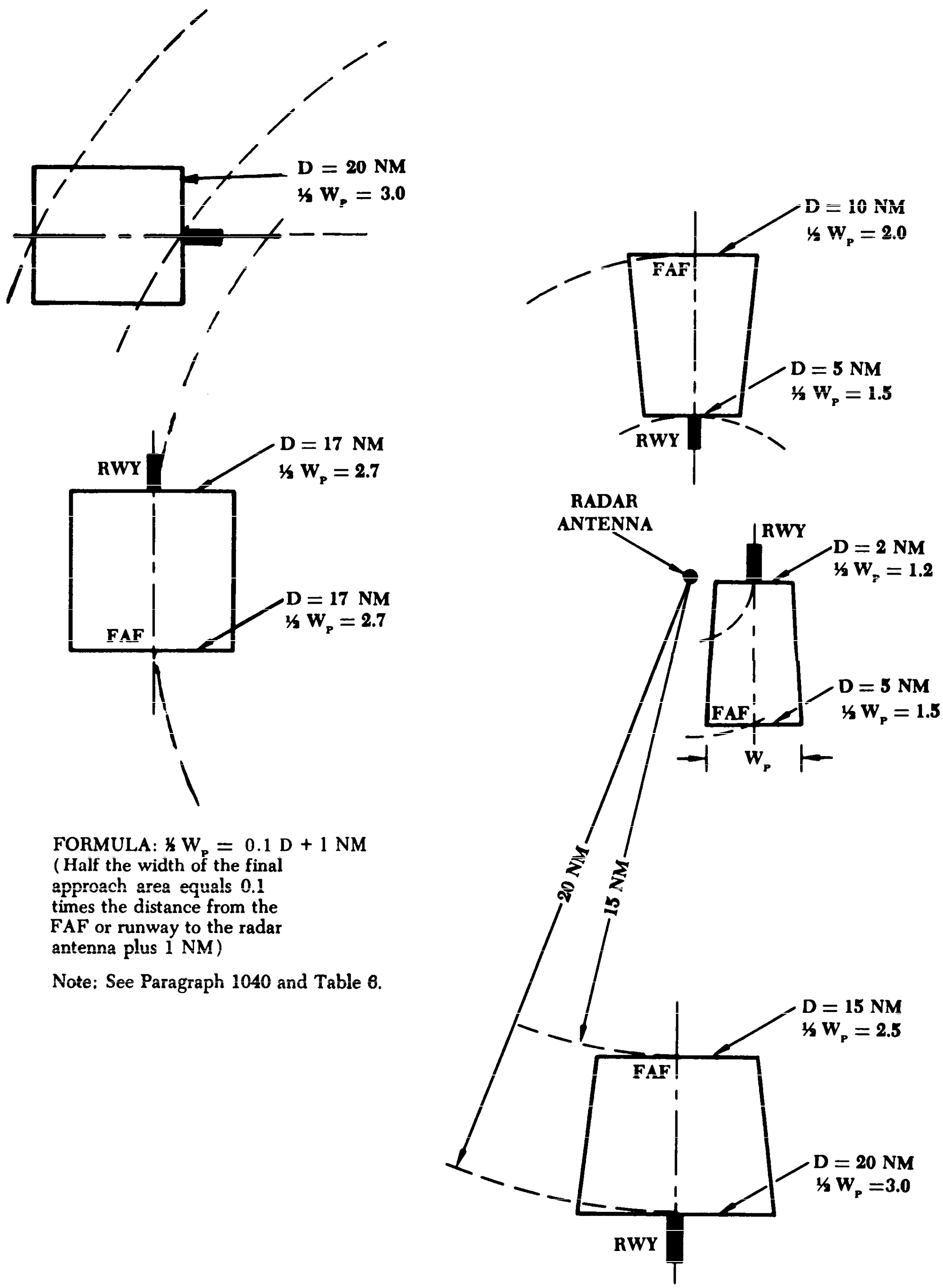


Figure 103. TYPICAL ASR APPROACH SEGMENTS. Par 1044.b.



FORMULA: ½ W_P = 0.1 D + 1 NM
(Half the width of the final approach area equals 0.1 times the distance from the FAF or runway to the radar antenna plus 1 NM)

Note: See Paragraph 1040 and Table 6.

Figure 104. EXAMPLES OF ASR FINAL APPROACH AREA DIMENSIONS. Par 1044.b.

1044.d. DESCENT GRADIENT. The OPTIMUM descent gradient is 300 feet per mile. The MAXIMUM descent gradient is 400 feet per mile.

(1) **Straight-In Approach.** The descent gradient shall be computed using the distance from the FAF to the runway threshold and the difference between the altitude over the FAF and TDZ elevation.

(2) **Circling Approach.** The descent gradient shall be computed using the distance from the FAF to the MAP and the difference between the altitude over the FAF and MDA.

1045. DEVIATION FROM ESTABLISHED RADAR PATTERNS. Whenever it is necessary to deviate from established radar patterns, obstacle clearance prescribed in Paragraph 1041.b. for diverse vectors shall be provided by approved radar vectoring charts.

1046. RADAR MONITOR. The use of ASR to monitor aircraft flying a published procedure based on another navigation system is encouraged to increase accuracy and expedite air traffic flow. However, no reduction in obstacle clearance may be made as a result of such monitoring. This does not preclude establishment of radar fixes in such published procedures for the purpose of permitting descent to a lower altitude.

1047. LOST COMMUNICATION PROCEDURES. The ASR procedure shall include instructions for the pilot to follow in the event of loss of communications with the radar controller. Alternate lost communication procedures shall be established for use where multiple approaches are authorized.

1048. MISSED APPROACH SEGMENT. The criteria for the missed approach segment are contained in Chapter 2, Section 7. The missed approach point is on the final approach course not farther from the final approach fix than the runway threshold (first usable portion of the landing area for circling approach). The missed approach surface shall commence over the MAP at the required height. See Paragraph 274.

1049. RESERVED.

Section 5. Simultaneous PAR Procedures

1050. GENERAL. Where facilities and equipment are available to support the requirement, PAR approach procedures to parallel runways may be established. The criteria specified in Chapter 9, Section 9, for simultaneous ILS procedures shall be used as a guideline in developing such procedures.

1051. – 1059. RESERVED.

Section 6. Airborne Radar Procedures

1060. GENERAL. Airborne radar procedures will be developed and published for military use at a later date.

1061. – 1099. RESERVED.